

What do Culturally Diverse Students in New Zealand Value Most for their Mathematics Learning?

Julia L Hill

University of Melbourne

<julia.hill@student.unimelb.edu.au>

Classrooms around the world are becoming increasingly diverse. A major challenge faced by educators is achieving equity for all mathematics learners. To achieve equity, educators need to acknowledge and cater for this increasing diversity which includes attending to values of their students. Drawing on survey responses and individual interviews, this paper explores the mathematics education values espoused by 227 middle school students in New Zealand, including Pākehā/European, East Asian, Māori and Pāsifika learners. Results from this study provide insight into what is valued in the mathematics classroom and may assist teachers to develop pedagogy and classroom culture which aligns with students' values.

New Zealand, like many countries, has an increasingly diverse student population. The latest Ministry of Education (MoE) reports (2016) show that 51% of all New Zealand school students identify as Pākehā/European, 24% as Māori, 10% as Pāsifika, 11% as Asian, and 2% as Middle Eastern/Latin American/African. The term Pākehā refers to people of non-Māori heritage, typically of White European descent. Māori are the indigenous cultural group of New Zealand. Pāsifika describes a multi-ethnic group of individuals who were born in New Zealand, or who migrated from the Pacific Islands. This group identifies themselves with the islands and/or cultures of Cook Islands, Samoa, Tonga, Tokelau, Niue, Fiji, Tuvalu, and the Solomon Islands.

Currently, New Zealand has one of the largest ethnically driven achievement gaps across all developed countries, with Māori and Pāsifika students much more likely to underachieve comparable to all other ethnicities (Education Assessment Research Unit and New Zealand Council for Educational Research, 2015). To disrupt these trends and achieve equity for students from all cultures, educators must attend to diversity by enacting culturally responsive teaching practices (Averill, Te Maro, Easton, Rimoni, & Smith, 2015). Several research studies (e.g., Civil & R. Hunter, 2015; J. Hunter et al., 2016) show equitable education outcomes can be achieved when we attend to cultural values in the classroom. However, there appears to be minimal research specifically exploring the types of values espoused by mathematics learners from different cultures, particularly for students from indigenous or marginalised cultures.

Values are a relatively recent field in mathematics education research. Values have been conceived as a dimension of our affective system (the other affective dimension being our beliefs, attitudes and emotions); as a motivational trait; volitional in nature; or as a sociocultural construct (Seah, 2016). For the purpose of this study, values will be defined as "the deep affective qualities which education aims to foster through the school subject of mathematics" (Bishop, 1996, p. 169) and are reflected by the "convictions which an individual has internalised as being the things of importance and worth" (Seah & Andersson, 2015, p. 169).

Bishop (1996) proposed three types of values found in mathematics education: (a) moral or general education values (e.g., *fairness, respect*); (b) mathematics values which relate to mathematics as a discipline (e.g. mathematics is about *control*); and (c) mathematics education values which relate to learning and pedagogy (e.g., valuing *group work*). The present study will

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focus on the third subtype, mathematics education values, as these values contribute to effective mathematics learning because they reflect the personal and cultural learning preferences of both teachers and students. Specifically, this paper will explore the following research question: what are the most important mathematics education values espoused by a cohort of culturally diverse learners in New Zealand?

International Literature Exploring Mathematics Education Values

There appears to be a scarcity of literature specifically exploring the types of mathematics education values espoused by students from different cultures, with the majority of research focusing on East Asian countries. After reviewing the East Asian values literature (Law, Wong, & Lee, 2011; Lim, 2015; Zhang et al., 2016; Zhang & Seah, 2015) the most consistently reported mathematics values included values internal to the student, for example *achievement, effort and practice*; as well as external values relating to the teacher or pedagogy, for example *teacher led activities, teacher creativity, explanations, strictness, board work*, and instruction involving *multiple methods*. For example, Zhang and colleagues (2016) found that students across China valued *achievement* as the most important aspect of their mathematics learning.

Outside of Asia, a small number of research studies have explored the mathematics education values espoused by Swedish (Österling & Andersson, 2013; Österling, Grundén, & Andersson, 2015) and Australian (Seah & Peng, 2012) students. These studies reported several internal mathematics education values, such as *achievement, memorisation/recall, effort/practice, and concentration*; as well as external values relating to the teacher and pedagogy, for example, *personalised help* from the teacher, *clarification* and *explanations, hints, worked examples, strictness, a quiet/relaxing classroom* and *problem solving*.

To date, there are no known research studies specifically exploring the types of mathematics education values espoused by students in New Zealand, however several studies provide some insight into valuing in New Zealand classrooms. For example, Anthony (2013) explored students' values towards a "good" mathematics teacher and student, comparing values from a high socio-economic and a low socio-economic school. Anthony reported that students from both schools valued a teacher who *cared* about his/her students, and who provided *clear explanations*. However, in terms of a "good" student, students from the high socio-economic school (and predominantly Asian and Pākehā/European ethnicities) expressed a high proportion of internal and independent learning values (e.g., *effort and practice, knowing multiple mathematical strategies*). In contrast, students from the low socio-economic school (and predominantly Pāsifika and Māori) espoused a greater proportion of collaborative values (e.g., *sharing, mathematical communication, respect*) compared to the other ethnic groups. Likewise, other studies (e.g., Hunter & Anthony, 2011; Sharma, Young-Loveridge, Taylor, & Hāwera, 2011) investigating Māori and Pāsifika perspectives on learning experiences in the mathematics classroom affirmed these students endorsed collaborative values in the mathematics classroom, such as *respect, positive relationships, reciprocity* and *group-work*.

However, it can be challenging comparing mathematics education values across the literature due to inconsistent methodologies and differences in the interpretation of values. For example, the values generated through interviews (e.g., Lee & Seah, 2015) may be very different to the values generated through questionnaires (e.g., Österling et al., 2015). Thus, to make valid cultural comparisons in mathematics education values, consistent methodologies are required.

Methodology

This paper reports on the mathematics education values espoused by a cohort of middle school students (Years 7 and 8) in New Zealand. The participants included 227 students from four urban schools, who identified as one of four ethnic backgrounds, including 30 Pākehā/European, 25 East Asian, 41 Māori and 131 Pāsifika students. The majority of the Pākehā/European and Asian students were from higher socio-economic home backgrounds and attended a high decile school. In this school, the teachers loosely followed the New Zealand Numeracy Project (MoE, 2009) and grouped students based on ability/achievement of specific goals. These Pākehā/European and Asian students usually worked independently, or within small groups. All the Pāsifika and Māori students attended one of three lower decile schools and came from low-socioeconomic home environments. These schools had been involved in an ongoing professional development and research project entitled Developing Mathematical Inquiry Communities (DMIC) (Hunter, Hunter, & Bills, in press). The DMIC project focuses on the development of culturally responsive teaching and pedagogical practices. Students in the DMIC project typically work in heterogeneous groups to engage in inquiry based mathematical activities.

The study followed a mixed methods approach and focused on the use of student voice to guide the interpretation of values. All students completed a survey where they ranked 12 mathematics education values in order of their importance: *utility, effort/practice, flexibility with strategies, accuracy, teacher explanations, mathematical clarity and understanding, family, peer collaboration/group-work, peer collaboration/communication, persistence, respect and belonging*. These values were drawn from policy documents and research literature (e.g., Clarkson, Bishop, FitzSimons, & Seah, 2000; MoE, 2011, 2013). As children often find it difficult to articulate their own values (Clarkson et al., 2000), each value was incorporated into a value statement, for example the statement “if I can’t solve a difficult maths problem I need to keep working at it” indicated the mathematics education value of *persistence*. Following the survey, all students were interviewed and asked why they had selected their three most important values.

To determine the degree of importance for each value, the proportion of students who ranked each of the twelve values in their top three values was analysed. All interview data was wholly transcribed and guided by a grounded theory approach where codes, categories and themes were developed from the data itself. For example, a student response explaining why they ranked the value *utility* as most important was: “most jobs probably involve maths so it will be important for it to be in my life” was coded into the node of future education/jobs.

Findings and Discussion

In Table One the four highest ranked mathematics education values for each of the four ethnic groups are identified. The following section explores student explanations for the top two values (bolded in Table 1) for each ethnic group to understand the importance of these values for the students.

Utility

The survey statement “*It is important for maths to be useful in real life or my future*” was used as a value indicator for the mathematics education value of *utility*. Students from all cultural groups expressed that *utility* was important for their mathematics learning, with around half ($n=111/227$) of all students ranking this value in their top three values.

Table 1

Summary of the Most Important Mathematics Education Values Across Cultural Group

Cultural Group (n)	Highest Ranked Values	Frequency (n)
Pākehā/European (30)	Utility	57% (17)
	Teacher explanations	53% (16)
	Clarity & understanding	43% (13)
	Flexibility	27% (8)
East Asian (25)	Utility	64% (16)
	Clarity & understanding	52% (13)
	Effort/practice	32% (8)
	Persistence	28% (7)
Māori (41)	Utility	39% (16)
	Peer collaboration/group-work	39% (16)
	Family	32% (13)
	Respect	29% (12)
Pāsifika (131)	Utility	42% (55)
	Peer collaboration/group-work	37% (49)
	Family	24% (31)
	Effort/practice	24% (31)

Note. The frequency column indicates the percentage and number of students in each ethnic group who ranked the value in their top three mathematics education values.

During follow up interviews, more than half the students ($n=54/104$) ranking *utility* in their top three expressed that proficiency in mathematics was important for their future education or career goals. This included students equating proficiency in mathematics with future employability: *Because if your maths skills aren't the best you might have a bit of trouble finding a job* (Asian male), or that engaging with mathematics allowed access to a specific occupation (e.g., teacher, banker, accountant). Other students identified that mathematics was important for their future education: *You can learn lots of maths for your future so that you might go to university* (Māori female). Alternatively, students ($n=39/104$) perceived utility as important for everyday and practical activities (e.g., shopping, building, money): *In my dad's job he needs to use it every day and we're doing renovations at our house and using maths to calculate area* (Pākehā/European male) and: *My Mum said if I never learn maths properly I won't know how to pay bills or count money* (Pāsifika male). Interestingly, these last two statements suggest that utilitarian values can be influenced by the values expressed by parents and also highlight the impact of out of school experiences.

Valuing *utility* means that these students desired mathematics which was either practical, or relevant to their own lives or the world around them. Students desired mathematics which had a purpose, that related to everyday activities, or which impacted upon their future success. Given the growing technological and digital economy (Ministry of Business Innovation and Employment 2017), there is a strong message in New Zealand that mathematics is important for future employment and economic advancement. Previously, Young-Loveridge and

colleagues (2006) found that an overwhelming majority of students held beliefs about the importance of mathematics for the future, suggesting that utilitarian mathematics values are reflective of societal values and not necessarily distinguishable by cultural differences.

Utilitarian mathematics education values have been reported elsewhere in the international values literature. For example, Österling and Andersson (2013) reported that Swedish middle school students highly valued “connecting mathematics to real life” (p.22). Similarly, Barkatsas and Seah (2015) found the favourite mathematical tasks reported by students across Australia and China involved real life scenarios. The strong *utility* values held by students both in the current study and other published research reaffirms the need for mathematics teachers to provide authentic learning experiences with opportunities for students to apply concepts and skills to real life scenarios. This is particularly important for marginalised students where linking school mathematics with the real world (of the students) improves mathematical engagement (Averill et al., 2015).

Teacher Explanations

The mathematics education value of *teacher explanations* was explored through the statement “*My maths teacher needs to explain it to me properly so I understand*”. This value was important for many of the Pākehā/European students, with fifty three percent ($n=16/30$) of these students ranking *teacher explanations* within their top three values.

The reason provided by all Pākehā/European students ($n=16/16$) for the choice of this value indicated they perceived that clear and accurate explanations from their teacher were necessary for their own mathematical progression and/or achievement. For example, one student stated: *A teacher is supposed to teach you what you’re doing and if I don’t understand it then I probably won’t be able to figure out that question*, whereas another student responded: *Because otherwise I get stuck and then I just don’t do it*. One student associated teacher clarity with her own performance in tests: *If my teacher doesn’t explain it properly then I won’t learn that and when I’m in a test I can’t remember it so in the test I don’t really do that well*.

The responses of these Pākehā/European students indicate that they often look to their teacher as the mathematical authority in their classroom, therefore, it was important to them that their teacher possessed relevant and expert mathematical knowledge. Values relating to *teacher explanations* have been reported in earlier research. For example, Seah and Peng (2012), as well as Österling and her colleagues (2015) reported that Swedish and Australian students valued *teacher explanations*, which included systematic and detailed teacher instructions. These Swedish and Australian students expressed the view that their peers often made mistakes which the students found confusing, therefore valuing the accuracy of their teachers’ explanations. Other research from New Zealand also demonstrates that students value *teacher explanations* as a component of effective mathematics learning (Anthony, 2013). For example, when Anthony explored what students valued for “good” mathematics teaching and learning, she found students from a predominantly Pākehā/European dominated school valued a *helpful teacher* who provided effective *explanations and clarity*.

Mathematical Clarity and Understanding

The statement “*It is important that maths is clear and makes sense to me*” was used as a value indicator for the mathematical education value of *mathematical clarity and understanding*. Fifty two percent of the Asian students ($n=13/25$) ranked this value in their first three values.

The majority of the Asian students ($n=10/13$) who ranked this value in their top three responded that mathematical *clarity and understanding* was important because it facilitated

their mathematical progression and achievement. For example, one student explained: *If you don't know what it means you don't know how to answer it, you need to understand and it needs to be more clearer.* Two students also equated mathematical clarity with accuracy, for example a student explained: *Because if maths isn't clear it will be wrong.*

For these Asian students, valuing mathematical *clarity and understanding* meant that these students felt discontent when their mathematics did not make sense to them. The importance of this value for the Asian (and Pakeha/European students) may be a reflection of mastery culture in their classroom. Earlier research from New Zealand (Meissel & Rubie-Davies, 2016) found that the majority of Pākehā/European and Asian mathematics students expressed strong mastery orientation goals. It appears the value of *clarity and understanding* has not appeared elsewhere in the values literature. In other research studies (e.g., Österling & Andersson, 2013; Seah & Peng, 2012; Zhang & Seah, 2015), students from Sweden, Australia and Asia expressed values relating to the source of their mathematical clarity and understanding (e.g., *worked examples, teacher explanations*).

Peer Collaboration/Group-Work

To investigate the mathematics education value of *peer collaboration/group-work*, the statement “*I learn more in maths by working with other children*” was used. Thirty-nine percent ($n=16/41$) of Māori students and thirty seven percent ($n=49/131$) of Pāsifika students ranked this statement within their top three values.

During follow up interviews it appeared that there was link between this mathematics education value and a key Māori and Pāsifika cultural value of *reciprocity* (MoE, 2011, 2013). Students viewed *peer collaboration/group-work* as providing reciprocal learning opportunities: *Because you can help other children and that would help you* (Māori male). Many Māori ($n=12/16$) and Pāsifika ($n=34/49$) students spoke of the benefits of working together, sharing new strategies and gaining new knowledge from their peers. For example, a Māori student responded: *Because we have more than one idea when we're working with someone*, also a Pāsifika student stated: *So you can get different strategies*. Alternatively, a smaller group of Māori ($n=3/16$) and Pāsifika ($n=8/49$) students discussed the opportunities they had themselves to help others, for example one student explained: *So when they are stuck I can help them* (Pāsifika female).

Collaboration is a core collectivist cultural value for Māori and Pāsifika people (MoE, 2011, 2013). In this study, the Māori and Pāsifika students valued *group work* because sharing ideas and strategies helped the students to progress and improve their own, and their peers' mathematics. Earlier research by Sharma and her colleagues (2011) found that Pāsifika students recognised the benefit of collaborative mathematical learning both for building their own mathematical understanding and progressing their peers' mathematical understanding. Similarly, Anthony (2013) found that Pāsifika students valued a social arrangement in the classroom, which suited their collaborative ways of learning. This contrasts research from Asia (e.g., Law et al., 2011; Zhang et al., 2016) which demonstrated an absence of collaborative mathematics values from East Asian students and research from Sweden (Seah & Peng, 2012) that highlighted Swedish middle school students valuing *independent working* due to their perception that listening to their peers' conflicting strategies was confusing rather than helpful.

Conclusion and Implications

Understanding what students' value in the mathematics classroom is important and has implications for effective and culturally responsive mathematics instruction. In the New

Zealand context, it appears that there has been limited research exploring students' self-reported mathematics values. The findings from the current study provide a useful starting point for developing an evidence base in New Zealand, particularly for marginalised students, as well as contributing to the international literature relating to the role of values and valuing in mathematics education.

In the current study, students from all ethnicities valued the *utility* of mathematics. The commonality of this value across international research studies (e.g., Barkatas & Seah, 2015; Lee & Seah, 2015; Lim, 2015; Österling & Andersson, 2013) suggests *utilitarian* values are influenced by societal and educational values. In terms of other important values, the Pākehā/European students espoused teacher focused and independent learning values (i.e., *teacher explanations, clarity and understanding, effort/practice*). Conversely, the Māori and Pāsifika students espoused collectivist mathematics education values (i.e., *peer collaboration/group-work, family, respect*). Opposing cultural values may, in part, explain these differences in the students' mathematics education values. For example, research studies (e.g., Hofstede, Hofstede & Minkov, 2010) show New Zealand (typically European) people hold individualist cultural values, whereas Māori and Pāsifika people endorse collectivist cultural values (MoE, 2011, 2013). An alternative explanation for these differences in mathematics education values may be linked to differences in classroom experience. The Māori and Pāsifika students were in classrooms involved in the DMIC project which promotes collaborative values and classroom norms. It would be valuable to investigate further the distinction between mathematics education values inculcated through cultural values, or the result of classroom experiences/pedagogy.

Acknowledging and harnessing values in the mathematics classroom has important implications for culturally responsive and effective mathematics teaching and learning. As Seah (2016) writes "how do we go about facilitating students' appropriate valuing such that it helps them to study mathematics more effectively? The first step would be to have a good idea of what is currently being valued by students" (p. 4). By recognising what is valued (or not valued) in the mathematics classroom, teachers can develop classroom culture or pedagogy which aligns with the students' values, or explicitly address inappropriate values, or values which may contradict the classroom norms and pedagogy.

References

Anthony, G. (2013). Student perceptions of the 'good' teacher and 'good' learner in New Zealand classrooms. In G. Kaur, M. Ohtani and D. Clarke (Ed.), *Student voice in mathematics classrooms around the world* (pp. 209-225). Rotterdam, Netherlands: Sense Publishers.

Averill, R., Te Maro, P., Easton, H., Rimoni, F., & Smith, D. (2015). Looking into equitable mathematics: Looking across many approaches In R. Averill (Ed.), *Mathematics and statistics in the middle years: Evidence and practice* (pp. 1-16). Wellington: New Zealand Council for Educational Research.

Barkatsas, T., & Seah, W. (2015). Learners' preferred mathematical task types: The values perspective. In A. Bishop, H. Tan & N. Barkatsas (Ed.), *Diversity in mathematics education* (pp. 63-79). Switzerland: Springer.

Bishop, A. (1996). *How should mathematics teaching in modern societies relate to cultural values-some preliminary questions*. Paper presented at the 7th Southeast Asian conference on Mathematics Education, Hanoi, Vietnam.

Clarkson, P., Bishop, A. J., FitzSimons, G., & Seah, W. T. (2000). Challenges and constraints in researching values. In M. Goos, R. Brown, & K. Makar (Eds.), *Proceedings of the 31st annual conference of the Mathematics Education Research Group of Australasia* (pp. 188-195). Brisbane: MERGA.

Civil, M., & Hunter, R. (2015). Participation of non-dominant students in argumentation in the mathematics classroom. *Intercultural Journal*, 26(4), 296-312.

Education Assessment Research Unit and New Zealand Council for Educational Research. (2015). *National monitoring study of student achievement: Mathematics and statistics 2013*. Wellington: Ministry of Education.

Hofstede, G., Hofstede, G. J., & Minkov, M. (2010). *Cultures and organizations, software of the mind. Intercultural cooperation and its importance for survival* (3rd ed.). New York: McGraw Hill.

Hunter, J., Hunter, R., Bills, T., Cheung, I., Hannant, B., Kritesh, K., & Lachaiya, R. (2016). Developing equity for Pāsifika learners within a New Zealand context: Attending to culture and values. *New Zealand Journal of Educational Studies*, 51(2), 197-209.

Hunter, R., & Anthony, G. (2011). Forging mathematical relationships in inquiry-based classrooms with Pāsifika students. *Journal of Urban Mathematics Education*, 4(1), 98-119.

Hunter, R., Hunter, J. & Bills, T. (in press). Enacting culturally responsive or socially-response-able mathematics education. In C. Nicol, S. Dawson, J. Archibald & F. Glanfield (Eds.). *Living culturally responsive mathematics curriculum and pedagogy: Making a difference with/in indigenous communities*. Netherlands: Springer.

Law, H. Y., Wong, N. Y., & Lee, N. Y. L. (2011). The Third Wave studies of values in effective mathematics education: Developing students' mathematical autonomy in classroom learning. *The Mathematics Educator*, 13(1), 72-86.

Lim, C. S. (2015). *Riding the Third Wave: Negotiating teacher and students' value preferences relating to effective mathematics lessons*. Paper presented at the meeting of the 12th International Congress on Mathematical Education, Seoul, Korea.

Meissel, K., & Rubie-Davies, C. M. (2016). Cultural invariance of goal orientation and self-efficacy in New Zealand: Relations with achievement. *British Journal of Educational Psychology*, 86(1), 92-111.

Ministry of Business Innovation & Employment. (2017). *Digital economy*. Retrieved 28 Sep 2017, from <http://www.mbie.govt.nz/info-services/science-innovation/digital-economy>

Ministry of Education. (2008). *Supporting Pāsifika students*, Wellington: Ministry of Education.

Ministry of Education. (2009). *What is the Numeracy Project?* Retrieved 2 July 2017, from <https://nzmaths.co.nz/what-numeracy-project>

Ministry of Education. (2011). *Tataiako: Cultural competencies for teachers of Māori learners*. Wellington: Ministry of Education.

Ministry of Education. (2016). *Education counts: School rolls*. Wellington: Ministry of Education.

Österling, L., & Andersson, A. (2013). Measuring immeasurable values. In A. Lindmeier & A. Heinze (Eds.). *Paper presented at the meeting of the 37th Conference of the International Group for Psychology of Mathematics Education* (pp. 17-24) Kiel, Germany: PME

Österling, L., Grundén, H., & Andersson, A. (2015). Balancing students' valuing and mathematical values. In B. Greer (Eds.), *Proceedings of the meeting of the Eight International Mathematics Education and Society Conference* (pp. 860-872) Portland, OR.

Seah, W. T. (2016). Values in the mathematics classroom: Supporting cognitive and affective pedagogical ideas. *Pedagogical Research*, 1(2), 45-63.

Seah, W. T., & Peng, A. (2012). What students outside Asia value in effective mathematics lessons: A scoping study. *ZDM: The International Journal on Mathematics Education*, 44(1), 71-82.

Sharma, S., Young-Loveridge, J., Taylor, M., & Hāwera, N. (2011). The views of Pāsifika students in New Zealand about communicating mathematically. *Asia Pacific Journal of Education*, 31(4), 503-519.

Young-Loveridge, J., Taylor, M., Sharma, S., & Hāwera, N. (2006). Students' perspectives on the nature of mathematics. In P. Grootenboer, R. Zevenbergen & M. Chinnappan (Eds.), *Proceedings of the 29th Annual Conference of the Mathematics Education Research Group of Australasia* (pp. 583-590) Adelaide: MERGA.

Zhang, Q., Barkatsas, T., Law, H.-Y., Leu, Y.-C., Seah, W. T., & Wong, N.-Y. (2016). What primary students in the Chinese mainland, Hong Kong and Taiwan value in mathematics learning: A Comparative Analysis. *International Journal of Science and Mathematics Education*, 14(5), 907-924.

Zhang, Q., & Seah, W. T. (2015). *Chinese secondary teachers' and students' perspectives of effective mathematics teaching: The underlying values*. Paper presented at the International Group for the Psychology of Mathematics Education, Michigan, United States: PME.